MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM JAPAN CIVIL AVIATION BUREAU TYPE APPROVAL DATA SHEET No. 746	TADS NUMBER 746 REVISION : 4 DATE : March 23, 2023 Rolls-Royce Deutschland Ltd. & Co. KG MODEL: Trent 900 Series Engines (Trent 970-84, Trent 970B-84 Trent 972-84, Trent 972B-84, Trent 972E-84, Trent 977-84, Trent 977B-84 and Trent 980-84)

Engines of models described herein conforming with this data sheet, (which is part of Type Approval Number 746) and other approved data on file with the Japan Civil Aviation Bureau, meet the minimum standards for use in certificated aircraft in accordance with pertinent aircraft data sheets and applicable portions of the Japan Civil Aeronautics Law and Regulations, provided they are installed, operated, and maintained as prescribed by the manufacturer's manuals and other instructions.

I. General

1. Type/ Model

Trent 970-84, Trent 970B-84, Trent 972-84, Trent 972B-84, Trent 972E-84, Trent 977-84, Trent 977B-84 and Trent 980-84

These models are approved for use on multi-engined civil aircraft classified in the Transport Category (Passenger) at the ratings and within the operating limitation specified below, subject to compliance with the powerplant installation requirements appropriate to approved installations.

2. Type Approval (TA) Holder Rolls-Royce Deutschland Ltd & Co KG
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3. Manufacture Rolls-Royce plc

4. Date of Application / Certification

Model	Date of application to EASA	EASA Type Certificate Issued / Revised	Date of application to JCAB	JCAB Type Approval Issued / Revised
Trent 970-84	April 3, 2002	October 29, 2004	January 7, 2013	April 7, 2015
Trent 970B-84	April 3, 2002	October 29, 2004	January 7, 2013	April 7, 2015
Trent 977-84	April 3, 2002	October 29, 2004	March 23, 2018	December 19, 2018
Trent 980-84	April 3, 2002	October 29, 2004	March 23, 2018	December 19, 2018

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Trent 977B-84	March 18, 2003	October 29, 2004	March 23, 2018	December 19, 2018
Trent 972-84	April 11, 2005	August 11, 2005	March 23, 2018	December 19, 2018
Trent 972B-84	April 11, 2005	August 11, 2005	March 23, 2018	December 19, 2018
Trent 972E-84	August 10, 2015	April 28, 2017	March 23, 2018	December 19, 2018

II. Certification Basis

1. JCAB Certification Basis

	1. Airworthiness Requirement (1) All models except Trent 972E-84 ✓ JAR-E, amendment 11, dated 1 November 2001 ✓ CS-E800(c) of CS-E, issue 1 for Large Flocking Bird Ingestion ✓ CS-E580(b) of CS-E, issue 1 for Failure of External Air Ducts (2) Model Trent 972E-84 ✓ JAR-E, amendment 11, dated 1 November 2001 ✓ CS-E800(c) of CS-E, issue 1 for Large Flocking Bird Ingestion 2. Special Conditions (All models) ✓ JAR-E 50 Programmable Logic Devices 3. Deviations (All models) ✓ JAR-E 890(a) Engine Calibration in Reverse Thrust 4. Equivalent Safety Findings (All models) ✓ JAR-E 740 150 Hour Endurance Test ✓ JAR-E 740(f) Non declaration or display of Maximum Continuous Speed Limitation ✓ JAR-E 800(c) Medium Bird Ingestion - Fan rig Test ✓ JAR-E 800(c)(iii) Medium Bird Ingestion - Flock encounter 5. Engine Emission requirement (1) All models except Trent 970-84, Trent 972-84 and Trent 972E-84 ✓ Civil Aeronautics Regulations Annex 3 Chapter 2 (equivalent to ICAO Annex 16, Volume II, Part III, Amendment 8, amended on January 1, 2015). (2) Models Trent 970-84, Trent 972-84 and Trent 972E-84 ✓ Civil Aeronautics Regulations Annex 3 Chapter 2 (equivalent to ICAO Annex 16, Volume II, Part III, Amendment 10, amended on January 1, 2021)

IMPORT REQUIREMENTS:	To be considered eligible for installation on Japan registered aircraft, each new engine to be exported to the Japan with UK CAA Form 1, Authorized Release Certificate. The UK CAA Form 1 should state that the engine conforms to the type design approved under the Japanese Type Approval No. 746-3, is in a condition for safe operation and has undergone a final operational check.
PRODUCTION BASIS	EASA Production Certificate Number UK.21G.2003

III. Technical Characteristics

1. Type Design Definition

The build standards are defined in the following Drawing Introduction Sheet (DIS) or later approved issues:

Trent 970-84	DIS 2244 Issue 4
Trent 970B-84	DIS 2245 Issue 4
Trent 977-84	DIS 2247 Issue 4
Trent 980-84	DIS 2249 Issue 4
Trent 977B-84	DIS 2248 Issue 4
Trent 972-84	DIS 2274 Issue 4
Trent 972B-84	DIS 2275 Issue 4
Trent 972E-84	DIS 2390 Issue 1

2. Description

The Trent 900 engine is a three shaft high bypass ratio, axial flow, turbofan with low pressure, intermediate pressure and high pressure compressors driven by separate turbines through coaxial shafts. The LP compressor fan diameter is 2.95m with a swept fan blade and outlet guide vanes to increase efficiency and reduce noise. The combustion system consists of a single annular combustor.
The LP and IP assemblies rotate independently in a counter clockwise direction, the HP assembly rotates clockwise, when viewed from back of the engine looking forward. The compressor and turbine have the following features:

Compressor	Turbine
LP - single stage	LP- 5 stage
IP – 8 stage	IP – single stage
HP – 6 stage	HP – single stage

The engine control system utilizes an electronic engine controller (EEC) which has an airframe interface for digital bus communications (AFDX).

3. Equipment

For details of equipment included in the type design definition: refer to the Installation manual.
For details of equipment supplied by the Airframe TC holder: refer to the Installation manual.

At engine certification, the engine has been approved for use with Aircell Thrust Reverser Unit (TRU) at the inboard engine positions (P/N ASE 0010-XX-0 for the left hand installation and ASE 0050-XX-0 for the right hand installation) and for a Fixed Fan Duct (FFD) in the outboard engine positions (P/N ASE 5010-XX-0 for the left hand installation and ASE 5050-XX-0 for the right hand installation).

The TRU and FFD do not form part of the engine type design and must be certified as part of the aircraft type design.

4. Dimensions

Overall Length mm (inch)	5,477.5 (215.65)
Maximum Diameter mm (inch)	3,944 (155.28)

Length - tip of spinner minus rubber tip to tail bearing housing plug mount flange
Diameter – around center line, including VFG Cooler, not including drains mast.

5. Dry Weight

Dry engine weight kg (lbs)	6,246 (13,769)

Not including fluids and Nacelle EBU.

6. Rating

The ISA sea-level static thrust ratings are:

Rating		Trent 970-84	Trent 970B-84	Trent 972-84	Trent 972B-84
Thrust, kN (lbf)	Take-off (net) (5 minutes)	334.29 (75,152)	348.31 (78,304)	341.41 (76,752)	356.81 (80,213)
	Equivalent Bare Engine Take-off	338.75 (76,155)	352.91(79,337)	345.95 (77,766)	361.51 (81,271)
	Maximum continuous (net)	319.60 (71,850)	319.60 (71,850)	319.60 (71,850)	319.60 (71,850)
	Equivalent Bare Engine Maximum Continuous	323.91 (72,818)	323.91 (72,818)	323.91 (72,818)	323.91 (72,818)

Rating		Trent 977-84	Trent 977B-84	Trent 980-84	Trent 970E-84
Thrust, kN (lbf)	Take-off (net) (5 minutes)	359.33 (80,781)	372.92 (83,835)	374.09 (84,098)	341.41 (76,752)
	Equivalent Bare Engine Take-off	364.07 (81,846)	377.83 (84,940)	379.00 (85,202)	345.95 (77,766)
	Maximum continuous (net)	319.60 (71,850)	319.60 (71,850)	319.60 (71,850)	319.60 (71,850)
	Equivalent Bare Engine Maximum Continuous	323.91 (72,818)	323.91 (72,818)	323.91 (72,818)	323.91 (72,818)

Refer to Notes 4 and 5.

7. Control System

The engine is equipped with a Full Authority Digital Engine Control (FADEC) system and an Engine Monitoring Unit (EMU).

Models	FADEC		EMU	
	EEC Software Standard	EEC P/N	EMU Software Standard	EMU P/N
Trent 970-84	RRY24-0106-380A or later approved standard	1002600-3 or later approved standard	271-123-800-411 or later approved standard	271-123-035-036 or later approved standard
Trent 970B-84				
Trent 977-84				
Trent 980-84				
Trent 977B-84				
Trent 972-84				
Trent 972B-84				

Trent 972E-84	RRY22-0122-380A or later approved standard			

Refer to the Installation Manual and Operating Instructions for further information. Refer to Note 2, 3 and 8.

8. Fluids (Fuel Oil, Coolant, Additives)
8.1 Fuel and Additives

Refer to the Operating Instructions for information on approved fuel and additive specifications for the Trent 900.

8.2 Oil

Refer to the Operating Instructions for information on approved oil specification for the Trent 900.

9. Aircraft Accessory Drives

The loads, weights and power extraction of the accessory gearbox aircraft power off takes (two hydraulic pumps and one variable frequency generator) are described in the Installation Manual.

10. Maximum Permissible Air Bleed Extraction

Environmental Control System Bleed and Wing Anti-icing Flow ('Customer Bleed') is bled from IP-8 off take at take-off, cruise and climb, and from HP-6 at descent and idle ground conditions.
At holding conditions (from 1524 m to 9144 m) (5000ft to 30000ft), switch-over from IP-8 to HP-6 off take takes place.
The maximum allowable Customer Bleed and nacelle thermal anti-icing flow is given in the table below.
Bleed flows vary linearly between the points listed.

Customer Bleed off-takes for Normal Operation

TET (T41)(°K)	Compressor Bleed (HP-6) % W26	Customer Bleed (IP-8) % W2.4
Low Idle to 1,251	12.5 to 12	n/a
1,251 to 1,545	12 to 5.5	n/a
1,545 to 1,672	n/a	5.11 to 4.1
1,672 to 1,787	n/a	4.1 to 1.95
1,787 to Max Take-off	n/a	1.95

At normal operating conditions (4 bleeds and 2 aircraft air-conditioning packs), air is bled from IP off take whenever IP port pressure is greater than 206.8kPa. For IP off take pressures lower than this value, air is bled from HP.

Customer Bleed off-takes for Abnormal Operation

TET(T41) (°K)	Compressor Bleed (HP-6) % W26	Customer Bleed (IP-8) % W2.4
Low Idle to 1,272	14.9 to 14.35	n/a
1,272 to 1,406	14.35 to 13.25	n/a
1,406 to 1,662	13.25 to 6.6	n/a
1,662 to 1,803	n/a	6.35 to 2.6
1,803 to Max Take-off	n/a	2.6

At abnormal operating conditions (2 bleeds and 1 aircraft air-conditioning pack), air is bled from the IP off take as long as the IP port pressure is greater than 231kPa (237.9 kPa in icing conditions); otherwise, air is bled from the HP off take.

The nacelle thermal anti-icing flow demand (HP3) is modulated via a regulating valve to provide a constant flow function at the engine/nacelle.

Nacelle Thermal Anti-Icing Bleed Off-takes for Normal and Abnormal Operations

TET(T41) (°K)	Nacelle Thermal Anti-Ice Bleed (HP-3) % W26
Low Idle to 1,160	1.19
1,160 to 1,565	1.19 linearly decreasing to 1.07
1,565 to 1,820	1.07 linearly decreasing to 0.50
1,820 to Max Take-off	0.50

Bleed is taken off the fan outlet to cool the air in the cabin bleed system pre-cooler. The maximum allowable pre-cooler flows are given in the table below. Bleed flows vary linearly between the points listed.

Pre-cooler Flow for Normal and Abnormal Operations

TET(T41) (°K)	Pre-cooler FLow (HP-3) % W120
Idle to 1,373	0.62
1,373 to 1,600	0.62 to 0.27
1,600 to 1,870	0.27

Note: W120 is Fan inlet flow

IV. Operating Limitations

1. Temperature Limits

1.1 Climatic Operating Envelope

The engine may be used in ambient temperatures up to ISA +40°C. Refer to the installation Manual for detail of the Operating Envelope, including the air inlet distortion at the engine inlet.

At take-off ratings, the Trent 970-84, 972-84, 972E-84, 977-84 and 980-84 are flat rated to ISA+15°C at all altitudes.
At take-off ratings, the Trent 970B-84, 972B-84 and 977B-84 are flat rated to ISA+10°C at all altitudes.

1.2 Turbine Gas temperature (TGT) - Trimmed(°C)

Maximum TGT(°C)	
Below 50 % HP speed, maximum during ground starts	700
Maximum during in-flight relights	850
Maximum for take-off (5 min. limit) – refer to Note 5	900
Maximum Continuous (unrestricted duration)	850
Maximum over-temperature (20-second limit) – refer to Note 14	920

Refer to Notes 5, 6 and 16.

1.3 Fuel temperature (°C)

Fuel Temperature (°C)	
Minimum in flight	-54
Maximum	
(i) On ground to top of climb	55
(ii) At the top of descent	50

Refer to Note 7. Refer to the Installation Manual for additional information.

1.4 Oil temperature (°C)

Combined Oil Scavenge Temperature (°C)	
Minimum for engine starting	
(i) with Special Starting Procedure	-40
(ii) with no Special Starting Procedure	-30
Minimum for acceleration to take off power	40
Maximum for unrestricted use	196

Note: In temperatures less than - 30°C but not less than -40°C, the Special Starting Procedure as defined in the Operating Instructions must be followed.

2. Pressure Limits

2.1 Fuel Pressure

Fuel Pressure - measured at the pylon interface – kPa (psi)	
Minimum absolute inlet pressure	34 (5)
Maximum pressure at inlet	
(i) Continuous	276 (40)
(ii) Transiently	690 (100)
(iii) Transiently	345 (50)

2.2. Oil Pressure

Oil Pressure– kPa (psi)	
Minimum oil pressure	
(i) Ground idle to 70 % HP rpm	172 (25)
(ii) Above 95 % HP rpm	344 (50)

3. Maximum / Minimum Permissible Rotor Speeds:

Maximum Permissible Rotor Speeds (rpm)	HP	IP	LP
Reference speeds, 100% rpm	12,200	8,300	2,900
Maximum for Take-off (5 minute limit)- refer to Note 5	97.8%	98.7%	97.2%
Maximum Over-speed (20-second limit)-Refer to Note 14	-	99.5%	-
Maximum Continuous Refer to Note 11	97.7%	97.8%	97.2%

For all engine models with their respective minimum approved software (defined in Section III.7) or later approved standard installed, the Control System prevents stabilized operation of the engine in the range of 64% to 72% LP shaft speed(N1) (Keep Out Zone) and above 78% LP shaft speed (N1) (Modified Engine Take-off Thrust Setting) during ground operations, in primary and rated reversionary forward thrust control models.

This function is designed against inadvertent operation by the following measures:-

- Protection is active only on the ground.
- Protection in enabled only below 60 knots.
- Protection is de-activated for flight once stabilized power is achieved, and is activated again only when TRA is retarded below Climb (i.e. Auto thrust disengaged).

The modified Engine Take-off Thrust Setting logic is active below 32.5 knots. The Keep Out Zone logic is active below 60 knots.
Passing through the 64% to 72% LP shaft speed range while increasing or decreasing thrust is not prevented.

4. Installation Assumptions:

Refer to Installation Manual for details.

5. Time Limited Dispatch

The engine has been approved for Time Limited Dispatch.
The maximum rectification period for each dispatchable state is specified in the Installation Manual.

V. Operating and Service Instructions

Document	Document Reference
Installation Manual Including Engine Control System Dispatch Limits	DKC 237292
Operating Instructions	OI-Trent-A380
Engine Manual	E-Trent-A380
Maintenance Manual	M-Trent-A380
Time Limits Manual	T-Trent-A380
Service Bulletins	RB211- as required

Refer to Note 10.

VI. Notes

1. Not used.

2. The software of the Engine Electronic Control is designated Level “A” as defined by EUROCAE ED-12B/RTCA DO178B.

3. The software of the Engine Monitoring Unit is in part designated Level “C” and part level “E” as defined by EUROCAE ED-12B/RTCA DO178B.

4. The Equivalent Bare Engine Take-off and Maximum Continuous thrusts quoted above is derived from the approved Net Take-off and Net Maximum Continuous thrust by excluding the losses attributable to the inlet, cold convergent nozzle, hot nozzle, by-pass duct flow leakage and the after body. No bleed or power off takes are assumed.

5. The take-off rating and the associated operating limitations may be used for up to 10 minutes in the event of an engine failure, but their use is otherwise limited to no more than 5 minutes.

6. Turbine Gas Temperature is measured by thermocouples positioned at the 1st stage Nozzle Guide Vane of the LP Turbine.

7. The fuel temperature is taken as that in the Wing Tank. The minimum and maximum fuel temperature and pressure are not measured on the engine and therefore, not provided to the flight deck. However, the wing tank temperature is available on the flight deck and it is assumed that there is negligible difference in temperature between the tank and the engine inlet.

8. Refer to Installation Manual for details of Electro-Magnetic interference (EMI), High Intensity Radiated Fields (HIRF) and Lightning capability.

9. Not used.

10. The engine components subjected to a limited service life are specified in the Airworthiness Limitations Section of the Time Limits Manual.

11. The Maximum Continuous speed limitations defined in this Data Sheet are not displayed as limitations on the A380 flight deck. In accordance with the Equivalent Safety Finding against JAR-E740(f), no display of these limitations is acceptable.

12. The acceleration from 15% to 95% rated take off power is 5,6 seconds.

13. Not used.

14. The Trent 900 is approved for a maximum exhaust gas over temperature of 920 degrees C (trimmed), and for a maximum IP over-speed of 99.5%, for inadvertent use for periods of up to 20 seconds without requiring maintenance action.
    The cause of the over temperature or over-speed must be investigated and corrected.

15. Not used.

16. TGT trimming, the EEC software contains a “Trimming” function. This takes the measured TGT value, reduces it by a pre-determined amount, and sends this trimmed TGT value to the cockpit display.

TGT Trim	Maximum Takeoff (5 min. limit, see Note 5)		Maximum Continuous (unrestricted duration)		Maximum Over-temperature (refer to Note 14)		Introduced by	Essential /Complementary Hardware
	Trimmed (°C)(1)	Un-trimmed (°C)(2)	Trimmed (°C)(1)	Un-trimmed (°C)(2)	Trimmed (°C)(1)	Un-trimmed (°C)(2)		
Profile 5	900	956	850	939	920	957	Minimum Service Standard	Not required
Profile 7	900	964	850	939	920	977	SB 72-G204	none
Profile 8 (3)	900	955	850	930	920	966	SB 73-G884	SB 72-G308
Profile 9 (3)	900	967	850	942	920	979	SB 73-G999	SB 72-G308
Profile 10 (4)	900	983	850	963	920	991	SB 73-H556	SB 72-G178, 72-G308, 72-G370, 72-G506, 72-G569

(1) Trimmed TGT is displayed in the cockpit
(2) Untrimmed TGT is the temperature measured on the engine (see Note 6)
(3) Profile 8 and 9 are applicable to the Trent 970-84 and 972-84 only.
(4) Profile 10 can be installed on the Trent 970-84 and 972-84 only, by way of the Service Bulletins and hardware requirements listed in the table. Profile 10 is also installed on the Trent 972E-84 as the Minimum Service Standard.

J1. This Type Approval Data Sheet (TADS) is based on EASA TCDS No. E.012 Issue 11, dated October 13, 2022.

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